

## **A Watershed-based Approach for Developing a Multi-Parameter TMDL In Sinclair- Dyes Inlet, Washington**

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The Sinclair-Dyes Inlet watershed TMDL project is an on-going, cooperative effort to monitor, characterize, and enhance water quality within this Puget Sound embayment. In the context of this project, water quality encompasses all the aspects of ecological integrity as defined by the CWA. The components of this ecosystem-based TMDL include physical, chemical, and biological parameters. Watershed partners include the federal, state, regional, and local entities, as well as the community within the Sinclair-Dyes Inlet watershed. The Washington State Department of Ecology is developing multiple TMDL plans with the support of all watershed partners. In particular, Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS&IMF), through its Project ENVVEST is leading the technical support effort. The goal of Project ENVVEST is to improve water-quality in the Sinclair-Dyes Inlet watershed. The project includes extensive freshwater, stormwater, and marine water quality monitoring, as well as the development of a watershed-based model. This project also explored the relationships between watershed urbanization and nearshore and upland water quality using a landscape scale analysis of the Sinclair-Dyes Inlet watershed. An empirical landscape-scale analysis of this urbanizing watershed was conducted using GIS techniques. Using bacterial contamination as the initial indicator of nearshore water quality conditions, the landscape factors that best explained water quality conditions were identified. Across the watershed, it was found that the loss of native forest cover and the expansion of impervious surfaces were the best predictors of nearshore water quality conditions. Within the more urbanized areas, the amount and connectivity of impervious surface areas, as well as the characteristics of wastewater treatment systems explained much of the variance in bacterial pollution. In addition, the type and extent of the stormwater conveyance and treatment network significantly influenced bacterial contamination levels in the nearshore environment. Using the data from this effort, an integrated model of upland and nearshore processes was developed for the watershed. The model has been calibrated and verified using sampling data. The model has been used to illustrate the extent and level of bacterial pollution within the Sinclair-Dyes Inlet watershed under a variety of situations. The model was also used to support opening of shellfish harvest areas within the watershed. This model will be extended to cover other pollutants and may be used by regulators to develop a multi-parameter TMDL implementation plan. The findings of these studies also have broad implications for land-use and stormwater management policies throughout Puget Sound.